CLAIMS

1. An apparatus for substrate processing, comprising:

a chamber comprising a bottom, a top, and a body disposed between the bottom and the top;

a first plasma source disposed about the chamber and defining a first plasma current path therein; and

at least one plasma shaping apparatus disposed adjacent the first plasma current path.

2. The apparatus of claim 1, wherein the first plasma source comprises a hollow member and wherein the at least one plasma shaping apparatus is disposed at one end of the hollow member.

3. The apparatus of claim 1, wherein the first plasma source comprises a pair of outlets wherein each outlet is registered with respective openings formed in opposing sides of the body.

4. The apparatus of claim 3, further comprising a substrate support member having a substrate receiving surface and wherein the respective openings in the opposing sides of the body are at least as wide as the substrate receiving surface.

5. The apparatus of claim 4, further comprising a showerhead connected to the top and in facing relationship with the substrate receiving surface and wherein the respective openings in the opposing sides of the body are disposed between the showerhead and the substrate receiving surface.

6. The apparatus of claim 1, further comprising a second plasma source disposed about the chamber and overlapping at least a portion of the first plasma source, wherein the second plasma source defines a second plasma path therein.

7. The apparatus of claim 6, wherein the first and second plasma sources each define an outlet at each of their respective ends and wherein the outlets of the first plasma source are registered with respective openings formed in a first pair of opposing sides of the body and the outlets of the second plasma source are registered with

respective openings formed in a second pair of opposing sides of the body.

8. The apparatus of claim 6, wherein the first and second plasma sources each comprise:

a hollow member, wherein each hollow member defines at least a portion of the respective first and second plasma paths therein.

9. The apparatus of claim 8, further comprising a coil disposed proximate each of the hollow members and adapted to produce a magnetic field therein.

10. The apparatus of claim 8, further comprising at least one other plasma shaping apparatus disposed adjacent the second plasma current path.

11. The apparatus of claim 10, wherein each of the plasma shaping apparatuses are disposed at an outlet of the respective hollow member.

12. The apparatus of claim 1, wherein the first plasma source comprises:

a hollow member defining at least a portion of the first plasma current path therein;

a plenum coupled to each end of the member, wherein each plenum is registered with a respective opening formed in the body.

13. The apparatus of claim 12, wherein the hollow member linearly traverses the top at about a midsection thereof.

14. The apparatus of claim 12, wherein the hollow member comprises at least a short transverse section of insulating member adapted to prevent the formation of a closed electrical path on the hollow member in about a longitudinal direction.

15. The apparatus of claim 12, further comprising a first antenna disposed over the top and adapted to inductively couple energy into the first plasma current path defined within at least a portion of the hollow member.

16. The apparatus of claim 15, wherein the antenna is a coil wound about at least one axis generally orthogonal to the first plasma current path.

17. The apparatus of claim 12, wherein the at least one plasma shaping apparatus is replaceable with one or more plasma shaping apparatus each defining a different geometric plasma shaping opening.

18. The apparatus of claim 1, wherein the at least one plasma shaping apparatus defines a plasma shape opening registered with an outlet of the first plasma source and wherein the plasma shape opening defines at least a first portion and a second portion, wherein the cross-sectional area of the first portion is different than the cross sectional area of the second portion.

19. The apparatus of claim 18, wherein the plasma shaping apparatus comprises a length and width dimension that is greater than the depth dimension.

20. The apparatus of claim 18, wherein the opening is sized about the same width and height as the outlet of the first plasma source and wherein the plasma shape opening define at least two outer portions and at least one inner portion, wherein the at least two outer portions are smaller than the at least one inner portion.

21. The apparatus of claim 1, wherein the at least one plasma shaping apparatus is a magnetic plasma shaping apparatus that provides a magnetic plasma shape opening within the first plasma path.

22. The apparatus of claim 21, wherein the magnetic plasma shaping apparatus comprises at least one magnetic element.

23. The apparatus of claim 20, wherein the at least one magnetic element comprises at least one of magnets, permanent magnets, electromagnets, and combinations thereof.

24. The apparatus of claim 21, wherein the magnetic plasma shaping apparatus position is adjustable relative the plasma.

25. The apparatus of claim 21, wherein the position of the magnetic element is adjustable relative the plasma.

26. A plasma generating system, comprising:

a first hollow member defining a first plasma current path;

a second hollow member defining a second plasma current path and disposed about orthogonal with respect to the first hollow member;

a first RF source disposed along a least a portion of the first hollow member and adapted to produce a first magnetic field within the first hollow member;

a second RF source disposed along a least a portion of the second hollow member and adapted to produce a second magnetic field within the second hollow member;

a first plasma shaping apparatus disposed at one end of the first hollow member; and

a second plasma shaping apparatus disposed at one end of the second hollow member.

27. The system of claim 25, wherein the first and second hollow members are made from a material selected from the group consisting of aluminum, anodized aluminum, stainless steel, ceramic, glass, and combinations thereof.

28. The system of claim 25, wherein the first and second hollow members each have a gas inlet.

29. The system of claim 25, wherein the first pair of plasma shaping apparatus define a first axis and the second pair of plasma shaping apparatus define a second axis substantially orthogonal with respect to the first axis.

30. The system of claim 25, wherein each of the first pair of plasma shaping apparatus are in facing relationship and each of the second pair of plasma shaping apparatus are in facing relationship.

31. The system of claim 25, wherein the first and second pairs of plasma shaping apparatuses define an opening having a width at least equal to a substrate to be processed within a region between the openings defined by the plasma shaping apparatus.

32. The system of claim 25, further comprising:

a substrate support member and a bias RF source coupled to the substrate support member.

33. The system of claim 31, further comprising:

a showerhead and a showerhead RF source coupled to the showerhead.

34. The system of claim 25, wherein the first and second pair of plasma shaping apparatuses each define a plasma shape opening defining a desired plasma density profile therethrough.

35. The system of claim 33, wherein each plasma shape opening defines at least two plasma shaping regions having different geometries from one another.

36. A plasma shaping apparatus, comprising:

a body including an inner surface defining an opening to allow plasma therethrough, wherein the opening has a cross section of varying dimensions to affect plasma current flowing through the opening.

37. The apparatus of claim 35, further comprising an outer vacuum chamber mating surface adapted to mate with a vacuum chamber surface, and a plasma source coupling face adapted to be coupled to a plasma source.

38. The apparatus of claim 35, further comprising an inner face adapted to communicate with a processing region of a vacuum chamber defining the vacuum chamber surface.

39. The apparatus of claim 35, wherein the body is replaceable with one or more other plasma shaping apparatuses each having an opening with a different cross-sectional geometry.

40. The apparatus of claim 35, comprising movable portions which allow the shape of the opening to be changed during a process or between sequential processes to produce a desired plasma distribution in the process region.

41. The apparatus of claim 35, comprising at least one magnetic element defining the inner surface to provide at least one magnetic field to form the opening therein.

42. The apparatus of claim 40, wherein the at least one magnetic element comprises electromagnets, permanent magnets, and combinations thereof.

43. The apparatus of claim 40, wherein the opening is defined by at least one magnetic field wherein the at least one magnetic field is adjusted to define the magnetic opening generally orthogonal to and within the plasma current flow.

44. The apparatus of claim 40, wherein the at least one magnetic element is defined by a first magnetic element disposed adjacent to and juxtaposed a second magnetic element, wherein the magnetic fields generated by the first and second magnetic elements define the at least one magnetic opening.

45. A method of substrate processing, comprising:

flowing a first gas into a first plasma current path defined by a first hollow member located external to a processing region;

applying power to a first antenna adjacent the first hollow member to inductively couple energy into the first gas to form a first plasma current generating a first plasma from the first gas;

flowing the first plasma generating current across the processing region and through another end of the first hollow member to define a first closed plasma current path; and

flowing a process gas through a showerhead into the processing region and forming a plasma of the process gas adjacent a substrate using the first plasma of the first gas.

46. The method of claim 44, wherein the first gas comprises at least one of nitrogen, hydrogen, oxygen, nitrous oxide, any of the Group VIII noble gases including argon and helium, ammonia, chlorine, boron trichloride, hydrogen chloride, and combinations thereof.

47. The method of claim 44, wherein the process gas comprises at least one of a deposition gas, cleaning gas, etch gas, and combinations thereof.

48. The method of claim 44, wherein the process gas comprises Trimethylsilane, silane, disilane, chlorinated silanes, TEOS, H_2, NF_3, Ar, He, and combinations thereof.

49. The method of claim 44, further comprising shaping the plasma current with a first and second plasma shaping apparatus located adjacent each end of the first hollow member.

50. The method of claim 48, wherein flowing the first gas adjacent each of the respective plasma shaping apparatuses comprises flowing the gases through an opening defined by each of the respective plasma shaping apparatuses, wherein each opening defines geometrically differently shaped regions.

51. The method of claim 49, comprising adjusting the geometry of the plasma-shaping apparatuses.

52. The method of claim 49, comprising exchanging one or more of the plasma-shaping apparatuses with one or more plasma shaping apparatuses having different geometrically shaped regions.

53. The method of claim 49, wherein the opening is registered with an outlet of the external plasma source and wherein the plasma shape opening defines a first portion and a second portion, wherein the second portion is narrower than the first portion.

54. The method of claim 48, further comprising flowing a second gas in a second plasma current path defined by a second hollow member located external to the processing region.

55. The method of claim 53, further comprising applying RF power to a second antenna in order to inductively couple energy into the second plasma current path and generating a second plasma from the second gas.

56. The method of claim 54, wherein the first and second gas comprise at least one of nitrogen, hydrogen, oxygen, nitrous oxide, any of the Group VIII noble gases including argon and helium, ammonia, chlorine, boron trichloride, hydrogen chloride, and combinations thereof.

57. The method of claim 54, wherein the first gas and the second gas are the same.

58. The method of claim 54, wherein the process gas comprises at least one of a deposition gas, etch gas, cleaning gas, or combinations thereof.

59. The method of claim 54, wherein the process gas comprises Trimethylsilane, SiH4, disilane, chlorinated silanes, TEOS, H_2, NF_3, Ar, He, and combinations thereof.

60. The method of claim 54, further comprising flowing the second plasma current adjacent a third plasma shaping apparatus adjacent one end of the second hollow member, and flowing a second plasma current across the processing region and adjacent a fourth plasma shaping apparatus located adjacent another end of the second hollow member to define a second closed plasma current path.

61. The method of claim 58, wherein flowing the first gas and second gas adjacent each of the respective plasma shaping apparatuses comprises flowing the gases through an opening defined by each of the respective plasma shaping apparatuses, wherein each opening defines geometrically differently shaped regions.

62. The method of claim 59, comprising adjusting the geometry of the plasma-shaping apparatuses.

63. The method of claim 59, comprising exchanging one or more of the plasma-shaping apparatuses with one or more plasma shaping apparatuses having different geometrically shaped regions.

64. The method of claim 59, wherein the opening is registered with an outlet of the external plasma source and wherein the plasma shape opening defines a first portion and a second portion, wherein the second portion is narrower than the first portion.

65. The method of claim 48, wherein the plasma shaping apparatus is a magnetic plasma shaping apparatus.

66. The method of claim 63, wherein the plasma-shaping apparatus comprises at least one magnetic field within the opening to shape the plasma within the first plasma current path.

67. The method of claim 64, comprising changing the magnetic field during a process or between sequential processes to shape the plasma.

68. The method of claim 65, wherein the plasma shaping apparatus includes at least one magnetic element and wherein changing the magnetic field comprises adjusting the at least one magnetic element.

69. The method of claim 66, wherein adjusting the magnetic element comprises positioning the magnetic element closer to or further from the plasma.

70. The method of claim 66, wherein the magnetic element is an electromagnet coupled to a current source to induce a magnetic field and wherein adjusting the magnetic element comprises adjusting the current source to increase or decrease the magnetic field.